UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
BIN C15700
Seattle, WA 98115-0070

May 28, 2002

Thomas F. Mueller
Chief, Regulatory Branch
Department of the Army
Seattle District, Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Biological Opinion for Columbia Pointe Development Community Dock (WHB-02-005)

Dear Mr. Mueller:

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.) and the Magnuson Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, the attached document transmits the National Marine Fisheries Service's (NMFS) Biological Opinion (BO) and MSA consultation on the issuance of a permit for construction of the Columbia Pointe Development Community Dock on the upper Columbia River in Douglas County, Washington. The Army Corps of Engineers (ACOE) determined that the proposed action may affect, but was not likely to adversely affect the Upper Columbia River steelhead (*Oncorhynchus mykiss*) and Upper Columbia River spring-run chinook (*Oncorhynchus tshawytscha*) Evolutionarily Significant Units (ESUs). The NMFS was unable to concur with this determination, and began formal consultation.

This BO reflects the results of a formal ESA consultation and contains an analysis of effects covering the Upper Columbia River steelhead and Upper Columbia River spring-run chinook in the Columbia River, Washington. The BO is based on information provided in the Biological Assessment (BA) sent to NMFS by the ACOE, and additional information transmitted via telephone conversations, fax, and e-mail. A complete administrative record of this consultation is on file at the Washington Habitat Branch Office.

The NMFS concludes that implementation of the proposed project is not likely to jeopardize the continued existence of Upper Columbia River steelhead or Upper Columbia River spring-run chinook or result in destruction or adverse modification of their Critical Habitat. In your review, please note that the incidental take statement, which includes a Reasonable and Prudent Measure and Term and Condition, was designed to minimize take.

The MSA consultation concluded that the proposed project may adversely impact designated Essential Fish Habitat (EFH) for chinook and coho salmon. The Reasonable and Prudent Measure of the ESA consultation, and Term and Condition identified therein, would address the negative effects resulting from the proposed ACOE actions. Therefore, NMFS recommends that they be adopted as EFH conservation measures.

The attached biological opinion contains an analysis of the effects of the proposed action on designated critical habitat. Shortly before the issuance of this opinion, however, a federal court vacated the rule designating critical habitat for the ESUs considered in this opinion. The analysis and conclusions regarding critical habitat remain informative for our application of the jeopardy standard even though they no longer have independent legal significance. Also, if critical habitat is redesignated before this action is fully implemented, the analysis will be relevant when determining whether a reinitiation of consultation will be necessary at that time. For these reasons and the need to timely issue this opinion, our critical habitat analysis has not been removed from this opinion.

If you have any questions, please contact Sean Gross of the Washington Habitat Branch Ellensburg Field Office at (509) 925-2631 x225.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

Enclosure

Endangered Species Act - Section 7 Consultation

Biological Opinion

And

Magnuson-Stevens Fishery Conservation and Management Act

Columbia Pointe Development Community Dock
Douglas County, Washington
WHB-02-005

Agency: Department of the Army, Corps of Engineers

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Issued by: for Michael R Crouse
D. Robert Lohn
Regional Administrator

Date: May 28, 2002

TABLE OF CONTENTS

1.0 INTRODUCTION

This document has been prepared in response to a request for consultation under the Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, *et. seq.* (ESA) and transmits the National Marine Fisheries Service's (NMFS) Biological Opinion (Opinion) and Essential Fish Habitat (EFH) consultation based on our review of the effects of the issuance of a permit to construct a dock in Douglas County, Washington. The project site is on the shore of Lake Entiat, on the upper Columbia River, within the Evolutionarily Significant Units (ESUs) of the endangered Upper Columbia River (UCR) steelhead (*Oncorhynchus mykiss*) and the endangered Upper Columbia River spring-run (UCRS) chinook (*Oncorhynchus tshawytscha*). Lake Entiat is also Essential Fish Habitat (EFH) for chinook and coho salmon.

1.1 Background Information

The Army Corps of Engineers (ACOE) concluded that the proposed project was not likely to adversely affect UCR steelhead, UCRS chinook and their designated critical habitats. However, ACOE also stated that the letter initiating informal consultation would also serve to initiate formal consultation if NMFS found the proposed action likely to adversely affect listed species. The NMFS has determined that the proposed action is likely to adversely affect listed species and has engaged the ACOE in formal consultation.

1.2 Consultation History

This document is based on information provided in the Biological Assessment (BA) and the following written correspondence: On January 9, 2002, NMFS received a letter initiating consultation (dated January 3, 2002) from the ACOE. On March 22, 2002, NMFS received a memorandum from Applied Environmental Services, a consultant to the applicant, detailing design modifications to the proposed structure. On April 12, 2002, NMFS received new design drawings for the proposed dock. On April 18, 2002, NMFS staff and the applicant met at Columbia Pointe to discuss site conditions and alternative dock designs. On April 25, 2002, NMFS received final design drawings for the proposed dock. Information necessary to conduct formal consultation was assembled by April 25, 2002.

Additionally, numerous telephone conversations between NMFS staff, ACOE, the applicant, and the applicant's agents are included in the administrative record.

1.3 Description of the Proposed Action

The ACOE proposes to issue a permit to Columbia River Properties to construct a four-slip community dock on the eastern shore of the Columbia River (Lake Entiat) in Douglas County, Washington, Section 6, Township 26N, Range 23E. The proposed dock would serve the proposed ten lot Columbia Pointe subdivision.

The float will consist of an approximately 8 x 70 foot center walkway with four 4 x 18 foot fingers and an 8 x 47 foot "T' at the waterward end. It will be attached to shore by a 4 x 14 foot ramp and a 4 x 20 foot pier anchored by a 2 x 4 foot concrete pad. The float deck surface will be composed of wood in the corners where the fingers or "T" attach to the center walkway. All other surfaces of the float, pier, and ramp will consist of welded bar grating with at least 60% of its surface area as open space. The float deck will be supported by white floats and six 6 inch steel pilings. The pier will be supported by four 5 inch pilings. The shoreward end of the float deck will be approximately 22 feet waterward of Ordinary High Water. The shallowest water depth beneath the float is estimated as at least 12 feet, and is more likely 16-20 feet. Most of the float is expected to over in water deeper than 20 feet.

Approximately four feet of vegetation along the shoreline will be permanently cleared to accommodate placement of the ramp. The only tree within the ramp corridor will be replanted adjacent to the ramp after construction. No other riparian vegetation will be disturbed. The staging area for construction will be above the dock site in an area that supports low-growing vegetation and is not thought to greatly contribute to riparian function. Construction will take place between July 1, 2002, and August 31, 2002, and will take 5-10 days.

1.4 Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 C.F.R. 402.02). The action area for this project is the Columbia River between Rocky Reach Dam and Wells Dam. Although most effects of the action will be localized, increases in predator populations and boating activity have the potential to affect listed salmonids throughout the reservoir. NMFS does not anticipate that the action will increase predator populations and boat traffic beyond these dams.

2.0 ENDANGERED SPECIES ACT

2.1 Biological Opinion

2.1.1 Status of Species and Critical Habitat

2.1.1.1 UCR Steelhead

UCR steelhead were listed as endangered pursuant to the ESA on October 18, 1997 (62 Fed. Reg. 43937). The ESU includes all naturally spawned populations of steelhead (and their progeny) in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border. Wells Hatchery stock steelhead are also part of the listed ESU.

Critical habitat for steelhead was designated on February 16, 2000 (65 Fed. Reg. 7764). Essential features of critical habitat for steelhead include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, and safe passage conditions. Recent and historical information related to abundance and life history is summarized in Busby *et al*. (1997).

The steelhead in the UCR ESU exhibit low abundance (Busby *et al.* 1997). Estimates of natural production in the ESU are well below replacement (approximately 0.3:1 adult replacement ratios estimated in the Wenatchee and Entiat Rivers). Five year (1989-93) average natural escapement estimates indicate 800 steelhead in the Wenatchee River and 450 steelhead in the Methow and Okanogan Rivers. Estimates of historical abundance (pre-1960's) specific to this ESU are available from fish counts at dams. Dam counts suggest a pre-fishery run size in excess of 5,000 adults for tributaries above Rock Island Dam (Chapman *et al.* 1994). The Federal Columbia River Power System (FCRPS) Opinion (NMFS 2000) concluded that significant improvements need to occur in the existing environmental baseline if this species is to recover.

For the UCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period (1980-1996) ranges from 0.94 to 0.66, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000b). NMFS has also estimated the risk of absolute extinction for the aggregate UCR steelhead population, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.25 (Table B-5 in McClure *et al.* 2000b). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 1.00 (Table B-6 in McClure *et al.* 2000b).

Because of data limitations, the Quantitative Analysis Report (QAR) steelhead assessments in Cooney (2000) were limited to two aggregate spawning groups—the Wenatchee/Entiat composite and the above-Wells populations. Wild production of steelhead above Wells Dam was assumed to be limited to the Methow system. Assuming a relative effectiveness of hatchery spawners of 1.0, the risk of absolute extinction within 100 years for UCR steelhead is 100%. The QAR also assumed hatchery effectiveness values of 0.25 and 0.75. A hatchery effectiveness of 0.25 resulted in projected risks of extinction of 35% for the Wenatchee/Entiat and 28% for the Methow populations. At a hatchery effectiveness of 0.75, risks of 100% were projected for both populations.

2.1.1.2 UCR Spring-run Chinook

UCR spring-run chinook were listed as endangered pursuant to the ESA on March 24, 1999 (64 Fed. Reg. 14308). The ESU includes all naturally spawned populations of chinook salmon in all river reaches accessible to chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Chinook salmon (and their progeny) from the following hatchery stocks are considered part of the listed ESU: Chiwawa River (spring run); Methow River (spring run); Twisp River (spring run); Chewuch River (spring run); White River (spring run); and Nason Creek (spring run).

Critical habitat for the UCRS chinook salmon was designated on February 16, 2000 (65 Fed. Reg. 7764). Essential features of critical habitat for chinook include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, and safe passage conditions. Recent and historical information related to abundance and life history is summarized in Busby *et al*. (1996).

The spring-run chinook abundance in the UCR ESU is quite low with escapements in 1994-1996 the lowest in at least the last 60 years (Meyers *et al.* 1998). At least 6 populations of UCR spring chinook salmon in this ESU have gone extinct, and almost all remaining naturally spawning populations have fewer than 100 spawners. In addition to extremely small population sizes, long-term trends in abundance are downward, some extremely so.

An estimate of the overall run returning to spawn naturally in this ESU can be obtained from counts of adults at Priest Rapids Dam. The 5 year (1990-1994) geometric mean of this dam-count based estimate is approximately 4,880 spawners. Sufficient data were available to estimate trends in abundance for ten populations. All ten short-term trends were downward, with eight populations exhibiting rates of decline exceeding 20% per year.

There are no estimates of historical abundance for this ESU. The FCRPS Biological Opinion (NMFS 2000) concluded that significant improvements in the environmental baseline are necessary if this species is to survive and recover. That Opinion concludes that survival must improve from 51% to 178% if this species is to survive and recover.

For the UCR spring chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period (1980-1998) ranges from 0.85 to 0.83, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000b). NMFS has also estimated median population growth rates and the risk of absolute extinction for the three spawning populations identified by Ford *et al.* (1999), using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (*i.e.*, hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from 0.97 for the Methow River to 1.00 for the Methow and Entiat rivers (Table B-5 in McClure *et al.* 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of extinction within 100 years is 1.00 for all three spawning populations (Table B-6 in McClure *et al.* 2000b).

NMFS has also used population risk assessments for UCR spring chinook salmon and steelhead ESUs from the draft QAR (Cooney 2000). Risk assessments described in that report were based on Monte Carlo simulations with simple spawner/spawner models that incorporate estimated smolt carrying capacity. Population dynamics were simulated for three separate spawning populations in the UCR spring chinook salmon ESU, the Wenatchee, Entiat, and Methow populations. The QAR assessments showed extinction risks for UCR spring chinook salmon of 50% for the Methow, 98% for the Wenatchee, and 99% for the Entiat spawning populations. These estimates are based on the assumption that the median return rate for the 1980 brood year to the 1994 brood year series will continue into the future.

2.1.2 Evaluating the Proposed Action

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 C.F.R. 402, *et. seq*. The NMFS must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify critical habitat. This analysis involves the initial steps of (1) defining the biological requirements of the listed species, and (2) evaluating the relevance of the environmental baseline to the species' current status.

Subsequently, NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NMFS must consider the estimated level of mortality attributed to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed salmon's life stages that occur beyond the action area. NMFS must identify any reasonable and prudent alternatives available for the action if it is determined that the action will jeopardize the listed species.

Furthermore, NMFS evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' critical habitat. The NMFS must determine whether habitat modifications appreciably diminish the value of critical habitat for both survival and recovery of the listed species. The NMFS identifies those effects of the action that impair the function of any essential element of critical habitat. The NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. NMFS must identify any reasonable and prudent alternatives available for the action if it is determined that the action will adversely modify critical habitat.

2.1.2.1 Biological Requirements

The relevant biological requirements are those necessary for UCR steelhead and UCRS chinook to survive and recover to naturally reproducing population levels at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

Biological requirements for these salmonids can be defined as properly functioning conditions (PFC) of habitats that are relevant to any steelhead or chinook life stage. These habitat conditions include all parameters of the matrix of pathways and indicators (MPI) described by NMFS (1996), *e.g.*, water quality, habitat access, flow/hydrology, and riparian reserves.

Presently, the biological requirements of listed species are not being met under the environmental baseline. As a general matter, to improve the status of the listed species, improvements in the functional condition of designated critical habitat are needed.

2.1.2.2 Environmental Baseline

The environmental baseline represents the current set of basal conditions to which the effects of the proposed action are then added. Environmental baseline is defined as "the past and present impacts of all Federal, State, and private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or informal section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation process" (50 C.F.R. 402.02).

The proposed project is located on the eastern shore of the Columbia River (Lake Entiat) in Douglas County, Washington, Section 6, Township 26N, Range 23E. The major factors influencing the environmental baseline within the action area include: (1) the presence of hydroelectric dams; (2) shoreline development (3) the NMFS Federal Columbia River Power System (FCRPS) Opinion.

Mainstem dams (Wells and Rocky Reach) are the most prominent features influencing the environmental baseline within the action area. Additional mainstem dams above and below the action area also influence the environmental baseline in the action area. In total, the mainstem dams have substantially changed the Columbia River's physical and biological characteristics. Specifically, dams have altered temperature profiles, inundated spawning habitat, created passage barriers, diminished sediment transport, prevented natural flow variation, eliminated lotic channel characteristics, and created habitat for species that prey on or compete with salmonids.

In terms of MPI indicators, the dams have caused a broad range of habitat degradation, contributing to high instream temperatures and high concentrations (supersaturation) of dissolved oxygen and nitrogen (Spence *et al.* 1996) in the Water Quality pathway. Portions of the action area have been identified on the State 303(d) list (Clean Water Act) for degraded temperature and total dissolved gas parameters (WSDOE 1998). The Temperature indicator is *not properly functioning*.

Indicators in the Habitat Elements pathway are *not properly functioning* for the following reasons. When the Columbia River was transformed from a flowing body of water to a series of slow moving reservoirs, much of the historic habitat was inundated and habitat functions were lost. Sediment transport has been restricted to the extent that fine materials (silt, sand) settle out of the water column in the reservoirs instead of being flushed downstream (causing sedimentation or floodplain deposition) (NMFS 1996). Additionally, low water velocity and the physical presence of the dams (both upstream and in the action area) traps spawning substrates, preventing downstream recruitment (NMFS 1996). Off-channel habitat, refugia (remnant habitat that buffers populations against extinction), and large woody debris production has been reduced by inundating off-channel areas and historic riparian zones. Because the flow is highly regulated between dams, hydraulic variation is lacking. The dams have created several large reservoir pools, leading to the alteration of mesohabitat distribution patterns and a loss of habitat diversity.

The dams within the action area inhibit passage of listed salmonids, creating conditions where listed salmonids may be killed or injured by mechanical impingement or high dissolved gas levels (NMFS 1996, Spence *et al.* 1996). Additionally, the dams create false attraction to impassable areas, habitat for predators, and otherwise delay the progress of migrants. The direct presence of the dams, as well as the secondary problems that they create, result in *not properly functioning* conditions for the MPI Physical Barriers Indicator within the action area.

The Floodplain Connectivity indicator is *not properly functioning* in the action area. Dam operations, flow (reservoir) management, and the related inundation of off-channel rearing and floodplain areas have reduced the size, quality, and function of floodplains along the Columbia River (NMFS 2000).

Finally, dams have affected the Change in Peak/Base Flows indicator to the extent that the indicator is *not properly functioning*. Dam operations, by design, restrict and control the passage of water through river basins. The hydrosystem on the Columbia River, including the action area, affects the natural hydrograph by decreasing spring and summer flows and increasing fall and winter flows (NMFS 2000).

The action area is affected by varying levels of shoreline development in the form of marinas, docks, residential dwellings, roads, railroads, rip-rap, bulkheads, and landscaping. In terms of the MPI, shoreline development has primarily affected the Habitat Elements and Channel Condition and Dynamics pathways. Shoreline development has reduced the quality of nearshore salmonid habitat by (1) eliminating native riparian vegetation, (contributing to the *not properly functioning* status for Large Woody Debris and Refugia indicators); (2) displacing shallow water habitat with fill materials (contributing to the *not properly functioning* status for the Off-Channel Habitat indicator); and (3) by further disconnecting the Columbia River from historic floodplain areas (contributing to the *not properly functioning* status for the Floodplain Connectivity indicator).

On December 21, 2000, NMFS issued the FCRPS Opinion (2000), finding that the FCRPS jeopardizes the continued existence and survival of UCRS chinook and UCR steelhead ESUs, among others. To avoid jeopardy, Federal agencies operating the FCRPS were provided a number of Reasonable and Prudent Alternatives (RPAs). In the RPAs, NMFS identified four categories of actions where survival and recovery of listed salmonids may be enhanced: hydroelectric, habitat, harvest, and hatcheries. It is important to note that a number of the RPAs involve off-site mitigation (*e.g.*, habitat improvements in estuaries and mainstem tributaries): modifying hydroelectric actions alone is insufficient to avoid jeopardy, as habitat improvement is also necessary.

The FCRPS Opinion illustrates that the environmental baseline is degraded within the action area and throughout the impounded Columbia and Snake Rivers. Maintaining current hydroelectric practices without additional improvements in habitat, harvest and hatchery areas would jeopardize the continued existence of UCRS chinook and UCR steelhead ESUs.

2.1.2.3 Factors Affecting Species Environment within Action Area

Section 4(a)(1) of the ESA and NMFS listing regulations (50 C.F.R. 424) set forth procedures for listing species. The Secretary of Commerce must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors; (1) the present or threatened destruction, modification, or curtailment of it habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

The proposed action includes activities that would have some level of effects with short-term impacts from the first category and the potential for long-term impacts from the third and fifth category. The characterization of these effects and a conclusion relating the effects to the continued existence of UCR steelhead and UCRS chinook is provided below, in sections 2.1.3 and 2.1.5.

Within the action area, Rocky Reach Dam to Wells Dam, substantial habitat modifications affect listed UCR steelhead and UCRS chinook. The most conspicuous habitat modification is caused by dams on the Columbia River. Essentially, the dams have transformed portions of the river from a lotic (free flowing) to lentic (standing water) environment. The establishment of slow flowing or stationary waters has altered the physical characteristics of the river. Compared to the historic lotic setting, portions of the Columbia River now have different hydraulics (very slow moving), thermal characteristics (temperature stratification, heat storage, etc.), substrate conditions (diminished sediment transport and increased sedimentation), as well as large artificial barriers to passage (Spence *et al.* 1996).

Concurrent with physical changes, indirect biological transformation has also occurred. Exotic species that prey on salmonids, including percids and centrarchids, have become established in the Columbia River (Wydoski and Whitney 1979). These predators may feed directly on salmonids (Tabor *et al.* 1993, Anglea 1997) or compete for other food or habitat resources. Other native predators including the pikeminnow have exploited the impounded environment created by dams, although their predation rates are higher in the lower Columbia River (Faler *et al.* 1988).

A number of general anthropogenic factors have also influenced listed species. Along the shore of the Columbia River, transportation infrastructure, agriculture, commercial and residential development have displaced riparian and shallow water habitat used by juvenile salmonids. This development also contributes some quantity of runoff and pollution, which may include sediments, fertilizer, pesticides, and petroleum products. Additionally, the management of nonnative fishes as a fishery resource perpetuates their existence in the reservoirs and may contribute to predation on salmonids.

2.1.3 Effects Of the Proposed Action

The proposed permitting of the construction of a dock in Lake Entiat is likely to adversely affect UCR steelhead and UCRS chinook. The portions of the Columbia River that flow through the action area are a migration corridor for steelhead and chinook adults and smolts and support juvenile rearing. The action area is within designated critical habitat for UCR steelhead and UCRS chinook.

The ESA implementing regulations define “effects of the action” as “the direct and indirect effects of an action on the species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline.” Indirect effects are those that are caused by the proposed action, are later in time, but are still reasonably certain to occur (50 C.F.R 402.02).

2.1.3.1 Direct Effects

Direct effects are the immediate effects of the project on the species or its habitat. Direct effects result from the agency action and include the effects of interrelated actions and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated.

Juvenile chinook and steelhead may inhabit the action area during the proposed construction period. Generally, the direct effects are related to the extent and duration (5-10 days) of construction activities. The negative direct effects associated with the proposed project are likely to be short in duration and will be minimized through restrictions in timing of construction.

2.1.3.1.1 Turbidity

Dock installation will mobilize sediments, temporarily increasing local turbidity levels. In the immediate vicinity of the construction activities (several meters), the level of turbidity would likely exceed the natural background levels by a significant margin and potentially affect fish.

Quantifying turbidity levels, and their effect on fish species, is complicated by several factors. First, turbidity from an activity will typically decrease as distance from the activity increases. How quickly turbidity levels attenuate is dependent upon the quantity of materials in suspension (e.g., mass or volume), the particle size of suspended sediments, the amount and velocity of ambient water (dilution factor), and the physical/chemical properties of the sediments. Second, the impact of turbidity on fishes is not only related to the turbidity levels, but also the particle size of the suspended sediments.

For salmonids, turbidity has been linked to a number of behavioral and physiological responses (i.e., gill flaring, coughing, avoidance, increase in blood sugar levels) which indicate some level of stress (Bisson and Bilby 1982; Sigler *et al.* 1984; Berg and Northcote 1985; Servizi and Martens 1992). The magnitude of these stress responses is generally higher when turbidity is increased and particle size decreased (Bisson and Bilby 1982; Servizi and Martens 1987; Gregory and Northcote 1993). Although turbidity may cause stress, Gregory and Northcote (1993) have shown that moderate levels of turbidity (35-150 NTU) accelerate foraging rates among juvenile chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect).

It is expected that turbidity arising from dock installation will be short lived. In-water installation operations will be limited to July 1 to August 31, when listed species are least likely to be present near the project site, minimizing the potential for adverse effects.

2.1.3.1.2 Pile Driving Noise

Pile driving typically causes temporary, intense underwater noise.. The extent to which the noise would disturb fishes would be related to the distance between the sound source and affected fish, and also by the duration and intensity of the pile driving operation.

In the marine environment, Feist *et al.* (1996) have demonstrated that pile driving has tangible effects on salmonids. Among their conclusions: salmonids may be affected by pile driving sound within a radius of 600 meters of the sound source, and pile driving operations may affect the general behavior and distribution of salmonids.

The noise caused by pile driving would likely elicit an evasive response from steelhead and chinook juveniles near the sound source. This evasive response could in turn result in juveniles abandoning predator refugia or local foraging areas, temporarily increasing risks of predation or diminishing foraging opportunities. The evasive response would also consume energy, potentially reducing growth.

It is expected that pile driving sound arising from dock installation will be short lived. In-water installation operations will be limited to July 1 to August 31, when listed species are least likely to be present near the project site, minimizing the potential for adverse effects.

2.1.3.2 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. Indirect effects might include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration. These actions must be reasonably certain to occur, or they are a logical extension of the proposed action.

2.1.3.2.1 Predation

Predation by smallmouth bass, largemouth bass, and possibly other species are expected to be increased by addition of the proposed docks. While NMFS is not aware of any studies which have been done to specifically determine impacts of in/over-water structures on salmon, there are numerous predation studies which suggest that there likely is a serious predation impact from these structures. Each of the structures is proposed to be located in an area where listed salmonids migrate and rear, and in an area where predators are present.

There are four major predatory strategies utilized by piscivorous fish: they run down prey; ambush prey; habituate prey to a non-aggressive illusion; or stalk prey (Hobson 1979). Ambush predation is probably the most common predation strategy. Predators lie-in-wait, then dart out at the prey in an explosive rush (Gerking 1994). Predators may use sheltered areas that provide slack water to ambush prey fish in faster currents (Bell 1991).

Light plays an important role in defense from predation. Prey species are better able to see predators under high light intensity, thus providing the prey species with a relative advantage (Hobson 1979). Petersen and Gadomski (1994) found that predator success was higher at lower light intensities. Prey fish lose their ability to school at low light intensities, making them vulnerable to predation (Petersen and Gadomski 1994). Howick and O'Brien (1983) found that in high light intensities, prey species (bluegill) can locate largemouth bass before they are seen by the bass. However, in low light intensities, the bass can locate the prey before they are seen. Walters et al. (1991) indicate that high light intensities may result in increased use of shade-producing structures by predators. In the ACOE fisheries handbook, Bell (1991) states that "light and shadow paths are utilized by predators advantageously."

The effect of over-water structures is the creation of a light/dark interface that allows ambush predators to remain in a darkened area (barely visible to prey) and watch for prey to swim by against a bright background (high visibility). Prey species moving around the structure(s) are unable to see predators in the dark area under the structure(s) and are more susceptible to predation.

Salmon stocks with already low abundance are susceptible to further depression by predation (Larkin 1979). Juvenile salmonids, especially ocean type chinook (among others), may utilize backwater areas during their outmigration (Parente and Smith 1981). The presence of predators may force smaller prey fish species into less desirable habitats, disrupting foraging behavior, depressing growth (Dunsmoor *et al.* 1991).

Predator species such as pikeminnow (*Ptychocheilus oregonensis*), and introduced predators such as largemouth bass, smallmouth bass, black crappie (*Pomoxis nigromaculatus*) white crappie (*P. annularis*) and potentially, walleye (*Stizostedion vitreum*) (Ward *et al.* 1994, Poe *et al.* 1991, Beamesderfer and Rieman 1991, Rieman and Beamesderfer 1991, Petersen *et al.* 1990, Pflug and Pauley 1984, and Collis *et al.* 1995) likely utilize habitat created by over-water structures (Ward and Nigro 1992, Pflug and Pauley 1984) such as docks, piers, and floats. However, the extent of increase in predation on salmonids in the Columbia River resulting from over-water structures is not well known. The *Proposed Recovery Plan for Snake River Salmon* states that there should be no programs that improve habitat, production or survival of introduced species" and that "recruitment of these species into habitats of the listed species should be curtailed" (NMFS 1995) to allow for the recovery of listed ESUs.

Major habitat types utilized by largemouth bass include vegetated areas, open water and areas with cover such as docks and submerged trees (Mesing and Wicker 1986). Colle *et al.* (1989) found that, in lakes lacking vegetation, largemouth bass distinctly preferred habitat associated with docks, a situation analogous to the Columbia River. Marinas also provide wintering habitat for largemouth bass out of mainstem current velocities (Raibley et al. 1997). Bevelhimer (1996), in studies on smallmouth bass, indicates that ambush cover and low light intensities create a predation advantage for predators and can also increase foraging efficiency. Wanjala *et al.* (1986) found that adult largemouth bass (*Micropterus salmoides*) in a lake were generally found near submerged structures suitable for ambush feeding. Bell (1991) states that predators may use sheltered areas of low velocity to attack.

Ward (1992) found that stomachs of pikeminnow in developed areas of Portland Harbor contained 30% more salmonids than those in undeveloped areas, although undeveloped areas contained more pikeminnows.

When taken as a whole, NMFS believes the scientific literature relating to predator/prey behavior indicates that the addition of in/over-water structures such as docks, likely increases predator success under certain conditions. We believe those conditions exist at the site of the proposed docks. These conditions include:

1. Presence of ambush-type predators or those which might benefit from the presence of in/over-water structures. Based on State Department of Fish and Wildlife electrofishing (Burley and Poe 1994), species known to occur in the Rocky Reach pool include largemouth bass, smallmouth bass, resident rainbow trout (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), walleye, yellow perch (*Perca flavescens*), channel catfish (*Ictalurus punctatus punctatus*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus macrochirus*), pumpkinseed (*Lepomis gibbosus*), peamouth chub (*Mylocheilus caurinus*), and chiselmouth (*Acrocheilus alutaceus*). Of these, largemouth and smallmouth bass are known ambush feeders. The extent to which in/over-water structures convey advantage to non-ambush predators is unknown, but there may be rearing benefits.

2. Presence of prey of a size vulnerable to predation. Both UCR steelhead and UCRS chinook must pass the proposed project sites when migrating to the ocean. It is also likely that some individuals of these ESUs rear in the project area.

3. Conditions which will be altered to the benefit of predator species. Depth and velocities at the project site appear to be conducive to use by rearing and migrating salmonids. Water clarity at the sites is such that predator and prey species currently enjoy good visibility. The addition of in-

water structure will likely provide cover/hiding refuge for predators. The addition of over-water structure will result in some level of shading which will provide hiding areas for predators from which they may capture salmonids.

Literature as well as personal observations substantiate the use of docks and other structures by juvenile predators for rearing purposes. Juvenile predators may derive a survival advantage from use of these structures by avoiding predation by their larger conspecifics (Carrasquero 2001). Smallmouth bass have been observed to preferentially locate nest sites near artificial structures (Pflug and Pauley 1984; K. Fresh pers. comm.). In the UCR, it is plausible that bass production is limited by the scarcity of structure. This action is likely to increase rearing and spawning habitat for predators, leading to an increase in population and predation on juvenile salmonids within the reservoir.

Based on the presence of young salmonids, predators, and the additional shading and structure created by the proposed dock and associated boats, it appears likely that the proposed action would contribute to increased predation of listed salmonids. The relative roles that added in/over-water structure itself and reduced light play in benefitting predaceous fish is unknown and the proposed action will minimize both types of effects by incorporating conservative design criteria. Surfacing most of the float and all of the pier and ramp with metal grating and using white materials for in-water structures will greatly reduce shading as compared to a traditional dock design. Using small diameter pilings spaced at least 18 feet apart is expected to reduce structure-dependent benefits to predaceous fish as compared to a traditional dock design. Positioning the float more than 20 feet from shore in water that is mostly greater than 20 feet deep is expected to reduce the interaction between predators and the most vulnerable juvenile salmonids and the potential for structure to create nearshore habitat that favors juvenile predators. Although the proposed design is expected to reduce the impact on UCR steelhead and UCRS chinook, NMFS expects take to occur.

2.1.3.2.2 Littoral Productivity

Docks may also have some general effects on littoral productivity. The shade that docks create may inhibit the growth of aquatic macrophytes and other plant life (*e.g.*, epibenthic algae and pelagic phytoplankton). These plants are the foundation for most aquatic food webs and their presence or absence affects many higher trophic levels (*e.g.*, invertebrates and fishes). Consequently, the shade from docks may affect local plant/animal community structure or species diversity. At a minimum, shade from docks may affect the overall productivity of littoral environments (White 1975, Kahler et al 2000). Surfacing the pier, ramp, and most of the float with metal grating and using white materials for in-water structures is expected to allow the greatest possible level of light beneath the proposed structure. Positioning the float more than 20 feet from shore in water that is mostly greater than 20 feet deep will further reduce impacts in the littoral environment.

2.1.3.2.3 Boating Activity

Adding a new residential dock is likely to increase levels of boating activity in the reservoir, especially near the dock. There are several impacts boating activity may have on listed salmonids and aquatic habitat. Engine noise, prop movement, and the physical presence of a boat hull may disrupt or displace nearby fishes (Mueller 1980, Warrington 1999a).

Boat traffic may also cause (1) increased turbidity in shallow waters, (2) uprooting of aquatic macrophytes in shallow waters, (3) aquatic pollution (through exhaust, fuel spills, or release of petroleum lubricants), and (4) shoreline erosion (Warrington 1999b). These boating impacts indirectly affect listed fish in a number of ways. Turbidity may injure or stress affected fishes, as discussed in more detail under Direct Effects, above. The loss of aquatic macrophytes may expose salmonids to predation, decrease littoral productivity, or alter local species assemblages and trophic interactions. Despite a general lack of data specifically for salmonids, pollution from boats may cause short-term injury, physiological stress, decreased reproductive success, cancer, or death for fishes in general. Further, pollution may also impact fishes by impacts to potential prey species or aquatic vegetation.

2.1.3.3 Population Level Effects

Construction of the proposed dock at Columbia Pointe will result in short- and long-term impacts to listed salmonids. Conservative design criteria are expected to reduce the potential for long-term harm to listed fish through increased predation and reduced littoral productivity. The action will negatively affect listed salmonids in the action area, but are not expected to be significant at the ESU scale for UCR steelhead or UCRS chinook.

2.1.3.4 Effects on Critical Habitat

The proposed action will affect certain essential features of the UCR steelhead and UCRS chinook critical habitat. The NMFS designates critical habitat based on physical and biological features that are essential to each listed species. Essential features of designated critical habitat include stream substrate, water quality, water quantity, water temperature, water velocity, food, riparian vegetation, access, and safe passage conditions for fish. The proposed construction activities will affect water quality, food, and safe passage conditions.

The direct and indirect effects listed previously include some discussion of impacts to critical habitat. Directly, these effects will include temporary increases in turbidity as well as aquatic sound levels. In terms of the essential features of critical habitat, sound and turbidity may decrease water quality, availability of food, and safe passage conditions. Docks have the greatest potential to affect critical habitat through indirect effects. As described above, the construction of overwater structures may secondarily create predator habitat or decrease littoral productivity. These effects include loss of cover/shelter, reduced safe passage conditions, and potential reductions in food availability.

Construction of the proposed dock at Columbia Pointe will result in short- and long-term impacts to critical habitat. Conservative design criteria are expected to reduce the potential for long-term impacts to listed fish through increased predation and reduced littoral productivity. These impacts are not expected to be great enough to appreciably reduce the functioning of already impaired critical habitat at the ESU scale. Consequently, the issuance of a permit for the installation of the proposed dock will not adversely modify the critical habitat of either UCR steelhead or UCRS chinook.

2.1.4 Cumulative Effects

Cumulative effects are defined as "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation" (50 C.F.R 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA

In the action area for this project, agricultural activities are the main land use. Riparian buffers are not properly functioning, containing little woody vegetation. Agricultural practices leave little stream buffer width. The NMFS does not expect any further habitat degradation from agricultural practices. NMFS assumes that non-Federal land owners in those areas will also take steps to minimize or avoid land management practices that would result in the take of those species. Such actions are prohibited by section 9 of the ESA, and subject to the incidental take permitting process under section 10 of the ESA.

2.1.5 Conclusion

NMFS has determined that the effects of the proposed actions will not jeopardize the continued existence of the UCR steelhead or UCRS chinook ESUs or result in the adverse modification or destruction of their critical habitat. The determination of no jeopardy is based upon the current status of the species, the environmental baseline for the action area, and the effects of the proposed actions.

The construction and installation of the dock at Columbia Pointe, as described and conditioned in this Opinion, would degrade baseline habitat functions locally, but would not appreciably reduce the functioning of already impaired habitat or retard the long-term progress of impaired habitat towards PFC at the population or ESU scale. This is due, in part, to the incorporation of conservative design criteria into the proposed action.

2.1.6 Reinitiation of Consultation

Consultation must be reinitiated if the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; new information reveals effects of the action may affect listed species in a way not previously considered; the action is modified in a way that causes an effect on listed species that was not previously considered; or, a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. 402.16).

2.2 Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined as significant habitat modification or degradation that results in death or injury to listed species by "significantly impairing behavioral patterns such as breeding, spawning, rearing, migrating, feeding, and sheltering" (50 C.F.R. 222.102). Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such takings is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the effects of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize take and sets forth terms and conditions with which the action agency must comply to implement the reasonable and prudent measures.

2.2.1 Amount Or Extent of Take Anticipated

The NMFS anticipates that incidental take of UCRS chinook and UCR steelhead is reasonably certain to result from project activities as described in the Opinion. Despite the use of the best scientific and commercial data available, NMFS cannot estimate a specific amount of incidental take of individual fish or incubating eggs. However, the mechanisms of expected effects are explained below. The extent to which these mechanisms will affect fish can be described and are in the effects analysis of this Opinion. Direct harm or injury may result from installation and construction activities that generate turbidity and intense sound. Indirect harm through long-term habitat modification is likely to occur as well and may result in long-term population impacts to the species if the dock is not constructed as described in the Opinion. In the accompanying biological opinion, NMFS determined that the level of anticipated take is not likely to result in jeopardy to the species or adverse modification of critical habitat.

2.2.2 Reasonable and Prudent Measures

The NMFS believes that the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of UCRS chinook and UCR steelhead:

1. The ACOE will minimize take by avoiding long-term degradation of aquatic habitat or enhancing aquatic predator habitat.

2.2.3 Terms and Conditions

To comply with ESA section 7 and be exempt from the prohibitions of ESA section 9, the ACOE must comply with the terms and conditions that implement the reasonable and prudent measures. These terms and conditions are non-discretionary.

1. To implement RPM No.1 above, the ACOE shall ensure that white dock components near the water surface (floats and the upper parts of pilings) are cleaned annually (prior to April) without chemicals such that the components remain bright and reflective through the spring outmigration of endangered salmonids.

2.2.4 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or action area, to help implement recovery plans, or to develop additional information.

The NMFS encourages the ACOE to more fully assess the long-term impacts that dock construction may have on anadromous salmonids in the action area. Such an assessment would include long-term projections for the number of docks that the ACOE intends to permit in the action area, an estimate of the cumulative impact of these docks and their indirect effects on salmonid populations, and the ability of these populations to survive and recover while so impacted.

The NMFS encourages the ACOE to evaluate the effectiveness of impact minimization measures included in the proposed action. These measures include: incorporating grating to increase light penetration through the structure, reducing the size and number of piles used, and painting piles and floats white.

Further, NMFS encourages the ACOE to explore avenues to improve salmonid habitat and ecosystem function in the action area to compensate for habitat impacts associated with docks and boating activity and to carry out programs for the conservation of endangered species.

The NMFS must be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitat. Accordingly, NMFS requests notification of the implementation of any conservation recommendations.

3.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));
- NMFS must provide conservation recommendations for any Federal or State activity that may adversely affect EFH (§305(b)(4)(A));
- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 C.F.R. 600.110). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810).

EFH consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

3.2 Identification of EFH

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of federally-managed Pacific salmon: chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*), and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

3.3 Proposed Actions

The proposed action and action area are detailed above in Sections 1.3 and 1.4 of this document. The action area includes habitats that have been designated as EFH for various life-history stages of chinook and coho salmon.

3.4 Effects of Proposed Actions

As described in detail in Section 2.1.3 of this document, the proposed action may result in detrimental short- and long-term impacts to a variety of habitat parameters. These adverse effects are:

3.4.1 Short-term degradation of water quality in the action area resulting from an increase in turbidity during in water construction.

3.4.2 Short-term increase in sound associated with pile driving.

3.4.3 Long-term increase in predation on juvenile chinook.

3.4.4 Long-term reduction in littoral productivity.

3.4.5 Long-term degradation in water quality and increased physical disturbance to river bottom and shore associated with increased boating activity.

3.5 Conclusion

NMFS believes that the proposed actions may adversely affect EFH for chinook and coho salmon.

3.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions that would adversely affect EFH. Because the conservation measures that the ACOE included as part of the proposed actions to address ESA concerns are also adequate to avoid, minimize, or otherwise offset potential adverse effects to chinook and coho salmon to the maximum extent practicable, conservation recommendations are not necessary.

3.7 Statutory Response Requirement

Since NMFS is not providing conservation recommendations at this time, no 30-day response from the ACOE is required (MSA §305(b)(4)(B)).

3.8 Supplemental Consultation

The ACOE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 C.F.R. 600.920(k)).

4.0 REFERENCES

Beamesderfer, R.C. and B.E. Rieman. 1991. Abundance and Distribution of Northern Squawfish, Walleyes, and Smallmouth Bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:439-447.

Bell, M.C. 1991. Fisheries handbook of Engineering requirements and biological criteria. Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers. North Pacific Division.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Can. J. Fish. Aquat. Sci. 42: 1410-1417.

Bevelhimer, M.S. 1996. Relative importance of temperature, food, and physical structure to habitat choice by smallmouth bass in laboratory experiments. Trans. Am. Fish. Soc. 125:274-283.

Bisson, P. A., and R. E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. N. Am. J. Fish. Manage. 4: 371-374.

Busby, P.J., R. Gustafson, R Iwamoto, C Mahnken, G Mathews, J. Myers, M. Schiewe, T. Wainwright, R. Waples, J. Williams, P. Adams, G. Bryant, C. Wingert, and R. Reisenbichler. 1997. Status Review Update for West Coast Steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Predecisional ESA Document. 68p.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. NOAA Tech. Memo. NMFS-NWFSC-27, 261 p.

Carrasquero, J. 2001. Over-water structures: freshwater issues. White paper, 12 April, 2001. Submitted to Washington State Department of Fish and Wildlife, Washington State Department of Ecology and Washington State Department of Transportation.

Chapman, D., C. Peven, T. Hillman, A. Giorgi, and F. Utter. 1994. Status of summer steelhead in the mid-Columbia River. Don Chapman Consultants, Inc, 318 p. (Available from Don Chapman Consultants, Inc., 3553 Rickenbacker, Suite 200, Boise, ID 83705.)

Colle, D.E., R.L. Cailteux, and J.V. Shireman. 1989. Distribution of Florida largemouth bass in a lake after elimination of all submersed aquatic vegetation. N. Am. Journal of Fish. Mgmt. 9:213-218.

Collis, K., R.E. Beaty and B.R. Crain. 1995. Changes in Catch Rate and Diet of Northern Squawfish Associated With the Release of Hatchery-Reared Juvenile Salmonids in a Columbia River Reservoir. North American Journal of Fisheries Management 15:346-357.

Cooney, T. D. 2000. UCR steelhead and spring chinook salmon quantitative analysis report. Part 1: run reconstructions and preliminary assessment of extinction risk. National Marine Fisheries Service, Hydro Program, Technical Review Draft, Portland, Oregon. December 20.

Dunsmoor, L.K., D.H. Bennett, and J.A. Chandler. 1991. Prey selectivity and growth of a planktivorous population of smallmouth bass in an Idaho reservoir. Pages 14-23 in D.C. Jackson (ed) The First International Smallmouth Bass Symposium. Southern Division American Fisheries Society. Bethesda, Maryland.

Faler, M.P., L.M. Miller, and K.I. Welke. 1988. Effects of variation in flow on distributions of northern squafish in the Columbia River below McNary Dam. N. Am. J. Fish. Manage. 8: 30-35.

Feist, B.E., J.J. Anderson, and R. Miyamoto. 1996. Potential impacts of pile driving on juvenile pink (*Oncorhynchus gorbuscha*) and chum (*O. keta*) salmon behavior and distribution. FRI-UW-9603. Fisheries Research Institute, School of Fisheries, University of Washington, Seattle.

Ford, M., P. Budy, C. Busack, D. Chapman, T. Cooney, T. Fisher, J. Geiselman, T. Hillman, J. Lukas, C. Peven, C. Toole, E. Weber, and P. Wilson. 1999. UCR steelhead and spring chinook salmon population structure and biological requirements. National Marine Fisheries Service, Northwest Fisheries Science Center, Upper Columba River Steelhead and Spring Chinook Salmon Biological Requirements Committee, Draft Report, Seattle, Washington. November 23.

Gerking, S.D. 1994. Feeding Ecology of Fish. Academic Press Inc., San Diego, CA. 416 pp.

Gregory, R. S., and T. S. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile chinook salmon (*Oncorhynchus tshawytscha*) in turbid laboratory conditions. Can. J. Fish. Aquat. Sci. 50: 223-240.

Hobson, E. S. 1979. Interactions between piscivorous fishes and their prey. Pages 231-242 in R.H. Stroud and H. Clepper, editors. Predator-prey systems in fisheries management. Sport Fishing Institute, Washington D.C.

Howick, G. L. and W.J. O'Brien. 1983. Piscivorous feeding behavior of largemouth bass: an experimental analysis. Trans. Am. Fish. Soc. 112:508-516.

Kahler, T., M. Grassley, and D. Beauchamp. 2000. A summary of the effects of bulkheads, piers, and other artificial structures and shorezone development on ESA-listed salmonids in lakes. Final report, 13 July, 2000. Prepared for the City of Bellevue, Washington by the Watershed Company, Kirkland, Washington, and Washington Cooperative Fish and Wildlife Research Unit, Univ. of Washington, Seattle, WA. 78p.

Larkin, P.A. 1979. Predator-prey relations in fishes: an overview of the theory. Pages 13-22 in R.H. Stroud and H. Clepper, editors. Predator-prey systems in fisheries management. Sport Fishing Institute, Washington D.C.

McClure, B. Sanderson, E. Holmes, C. Jordan, P. Kareiva, and P. Levin. 2000b. Revised Appendix B of standardized quantitative analysis of the risks faced by salmonids in the Columbia River basin. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. September.

Mesing, C.L. and A.M. Wicker. 1986. Home range, spawning migrations, and homing of radio-tagged Florida largemouth bass in two central Florida lakes. Trans. Am. Fish. Soc. 115:286-295.

Meyers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

Mueller, G. 1980. Effects of recreational river traffic on nest defense by longear sunfish. Trans. Am. Fish. Soc. 109: 248-251.

NMFS (National Marine Fisheries Service). 1995. Proposed Recovery Plan for Snake River Salmon. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

NMFS . 1996. Factors for decline: a supplement to the notice of determination for West Coast steelhead under the Endangered Species Act.

NMFS, Protected Resources Branch, Portland, Oregon. 2000. Federal Columbia River Power System Final Biological Opinion. National Marine Fisheries Service Northwest Region

Parente, W.D. and J.G. Smith. 1981. Columbia River Backwater Study Phase II. U.S. Dept of Interior. Fisheries Assistance Office. Vancouver, Washington. 87 pp.

Petersen, J.M. and D.M. Gadomski. 1994. Light-Mediated Predation by Northern Squawfish on Juvenile Chinook Salmon. Journal of Fish Biology 45 (supplement A), 227-242.

Petersen, C.J., D.B. Jepsen, R.D. Nelle, R.S. Shively, R.A. Tabor, T.P. Poe. 1990. System-Wide Significance of Predation on Juvenile Salmonids in Columbia and Snake River Reservoirs. Annual Report of Research. Bonneville Power Administration Contract DE-AI79-90BP07096. Project No. 90-078. 53 pp.

Pflug, D. E. and G. B. Pauley. 1984. Biology of smallmouth bass (Micropterus dolomieui) in Lake Sammamish, Washington. Northwest Science 58: 118-130.

PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Portland, Oregon.

Poe, T.P, H.C. Hansel, S. Vigg, D.E. Palmer, and L.A. Prendergast. 1991. Feeding of Predaceous Fishes on Out-Migrating Juvenile Salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:405-420.

Raibley, P.T., K.S. Irons, T.M. O'Hara, and K.D. Blodgett. 1997. Winter habitats used by largemouth bass in the Illinois River, a large river-floodplain ecosystem. N. Am. J. Fish. Mgmt. 17:401-412.

Rieman, B.E. and R.C. Beamesderfer. 1991. Estimated Loss of Juvenile Salmonids to Predation by Northern Squawfish, Walleyes, and Smallmouth Bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:448-458.

Servizi, J. A., and D. W. Martens. 1987. Some effects of suspended Fraser River sediments on sockeye salmon (*Oncorhynchus nerka*), p. 254-264. *In* H. D. Smith, L. Margolis, and C. C. Wood [ed.] Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. Can. Spec. Publ. Fish. Aquat. Sci. 96.

Servizi, J. A., and D. W. Martens. 1992. Sublethal responses of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. Can. J. Fish. Aquat. Sci. 49: 1389-1395.

Sigler, J. W., T.C. Bjornn, and F. H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Trans. Am. Fish. Soc. 113: 142-150.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon.

Tabor, R. A., R.S. Shivley, and T. P. Poe. 1993. Predation on juvenile salmonids by smallmouth bass and northern squawfish in the Columbia River near Richland, Washington. N. Am. J. Fish. Manage. 13: 831-838.

Walters, D.A., W.E. Lynch, Jr., and D.L. Johnson. 1991. How depth and interstice size of artificial structures influence fish attraction. N. Am. J. Fish. Mgmt. 11:319-329.

Wanjala, B.S., J.C. Tash, W.J. Matter and C.D. Ziebell. 1986. Food and habitat use by different sizes of largemouth bass (*Micropterus salmoides*) in Alamo Lake, Arizona. Journal of Freshwater Ecology Vol. 3(3):359-368.

Ward, D.L. (ed). 1992. Effects of waterway development on anadromous and resident fish in Portland Harbor. Final Report of Research. Oregon Dept. of Fish and Wildlife. 48 pp.

Ward, D.L. and A.A. Nigro. 1992. Differences in Fish Assemblages Among Habitats Found in the Lower Willamette River, Oregon: Application of and Problems With Multivariate Analysis. Fisheries Research 13:119-132.

Ward, D.L., A.A. Nigro, R.A. Farr, and C.J. Knutsen. 1994. Influence of Waterway Development on Migrational Characteristics of Juvenile Salmonids in the Lower Willamette River, Oregon. North American Journal of Fisheries Management 14:362-371.

Warrington, P. D. 1999a. Impacts of recreational boating on the aquatic environment. http://www.nalms.org/bclss/impactsrecreationboat.htm

Warrington, P.D. 1999b. Impacts of outboard motors on the aquatic environment. http://www.nalms.org/bclss/impactsoutboard.htm

White, S. T. 1975. The influence of piers and bulkheads on the aquatic organisms in Lake Washington. M.S. Thesis, Univ. of Washington, Seattle, WA. 132 p.

Wydoski, R. S. and R. R. Whitney. 1979. Inland Fishes of Washington. Univ. of Washington Press, Seattle, WA. 220 p.